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BREVET D'INVENTION

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Haut-parleur à large bande de fréquences et à double système vibrant.

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L'objet de la présente invention est un haut-parleur à double diaphragme dont le rendement se maintient pratiquement uniforme pour une gamme très étendue de fréquences.

On sait que des difficultés considérables s'opposent à la réalisation d'un haut-parleur à bobine mobile capable de maintenir un rendement uniforme, ou à peu près tel, dans toute l'étendue de la gamme acoustique. Dans les applications électro-acoustiques qui imposent la reproduction fidèle d'une gamme de fréquences étendue, on fait donc généralement appel à deux ou plusieurs haut-parleurs offrant des caractéristiques appropriées, et on affecte chacun d'eux à la reproduction d'une partie limitée de la bande des fréquences à couvrir. Pour obtenir un ensemble plus compact et pour réduire les interférences qui se manifestent aux fréquences de transition, on a établi des systèmes complexes dans lesquels se trouvent associés deux haut-parleurs de caractéristiques différentes qui sont assujettis l'un sur l'autre de façon à former un bloc unique. Ces haut-parleurs comportent deux systèmes vibrants, généralement coaxiaux, ayant des bobines mobiles excitées par des champs magnétiques dont les flux proviennent de deux sources séparées. Celles-ci, par exemple, sont composées de deux électro-aimants ou deux aimants permanents, coaxiaux et disposés intérieurement l'un à l'autre, ou coaxiaux et alignés l'un à la suite de l'autre. Ces dispositions offrent divers inconvénients : Tout d'abord, la disposition première ne permet pas de donner à l'électro intérieur les dimensions qui seraient nécessaires pour en faire la source d'un champ puissant, permettant d'obtenir un bon rendement pour le système vibrant destiné à la reproduction des notes élevées. Ensuite, la seconde disposition ne permet pas d'éliminer les effets nuisibles des interférences s'exerçant entre les sons émis par les deux diaphragmes en raison de l'impossibilité de disposer le plus petit diaphragme au sommet du plus grand comme il faudrait le faire pour éliminer ces effets. En outre, les dispositions indiquées conduisent l'une et l'autre à des complications d'ordre constructif. Les inconvénients qu'on vient de citer, et d'autres encore, disparaissent lorsqu'on adopte les dispositions qui font l'objet de l'invention.

On en comprendra mieux les caractéristiques et avantages en se référant à la figure jointe et à la description qui l'accompagne, données l'une et l'autre à titre d'exemple précisant seulement une forme de réalisation préférée de l'invention et n'offrant par conséquent aucun caractère limitatif.

Une première caractéristique fondamentale, mise en valeur dans cette figure, réside dans la réduction à un système unique de l'ensemble magnétique assurant l'excitation des bobines mobiles des deux diaphragmes. C'est un résultat qu'on a obtenu en apportant des modifications simples aux systèmes généralement adoptés pour exciter la bobine des haut-parleurs à diaphragme unique. Le changement consiste en une coupure telle du circuit magnétique que, par interposition d'un noyau annulaire 2, on y détermine deux entrefers concentriques. Grâce à cet anneau 2, supporté par l'anneau non magentique 4, lui-même rapporté sur l'extrémité cylindrique 3 du noyau 1, le flux créé par le courant passant dans l'enroulement d'excitation 9 est obligé de traverser le premier entrefer annulaire 5, dans lequel se meut la bobine mobile 6 du diaphragme 11 offrant la forme conique, et reproduisant les sons de basse fréquence et de moyenne fréquence.

Si en première approximation on néglige les fuites, la totalité du flux Φ gagne l'anneau 2 et il se subdivise en deux flux : le premier, Φ_1, franchit l'entrefer annulaire intérieur 7 dans lequel se déplace la bobine mobile 8 du diaphragme 12 affecté à la reproduction des notes élevées. Le second flux, Φ_2, franchit l'entrefer latéral 10 qui joue le rôle de « shunt » magnétique. Cet entrefer 10 à pour fonction de recueillir le flux Φ_2 qui ne pourrait pas passer à travers l'entrefer 7 à cause de la saturation de la couronne magné-

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6. Haut-parleur suivant 3 et 5 caractérisé par le fait que le petit diaphragme est fixé à sa bobine mobile par son rebord externe et que sa forme lui confère une grande rigidité;

7. Haut-parleur offrant la caractéristique précédente, et caractérisé encore par le fait que la pièce annulaire servant au centrage du petit diaphragme et de sa bobine, est profilée de façon à prolonger vers le centre du système la surface conique du grand diaphragme qui l'entoure.

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Loud-Speaker with wide frequency response and double vibrating system.

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The subject of the present invention is a double-diaphragm loud-speaker with a response which is practically uniform over a very wide range of frequencies.

It is known that there are considerable difficulties in the realisation of a moving-coil loud-speaker with a response which is uniform or nearly so, over the whole of the acoustic range. In the electro-acoustic applications which require faithful reproduction over a wide range of frequencies, the usual solution is to use two or more loud-speakers of appropriate characteristics, each of these reproducing a limited part of the frequency range to be covered. In order to obtain a more compact assembly and to reduce the interference effects which occur at the transition frequencies, complex systems have been produced in which there are associated two loud-speakers of different characteristics, fixed together so as to form one single unit. These loud-speakers have two vibrating systems, generally co-axial, with moving coils which are excited by magnetic fields whose fluxes are provided by two separate sources. These latter, for example, consist of two electro-magnets or two permanent magnets, either co-axial with one positioned inside the other, or co-axial and aligned one after the other. These arrangments are subject to various disadvantages: firstly, the first arrangement does not permit the interior electro-magnet to be of the dimensions necessary to make it provide a powerful field, which would lead to a good response for the vibrating system intended for reproduction of high notes. Then, the second arrangement does not make it

possible to eliminate the harmful effects of the interferences taking place between the sounds emitted by the two diaphragms, since it is not possible to position the smaller diaphragm on top of the larger, which would be necessary to eliminate these effects. In addition, the arrangements mentioned both lead to complications in their construction. The disadvantages which have just been mentioned, and others also, disappear when the arrangements forming the subject of the invention are used.

The characteristics and advantages of the invention will be better understood by reference to the attached drawing and to the explanation accompanying it, both these being given by way of an example giving only the details of a preferred form of the invention and in consequence not in any way limiting it.

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One first fundamental characteristic, shown in the drawing, lies in the reduction to a sole system of the magnetic group which leads to the excitation of the moving coils of the two diaphragms. This is a result obtained by means of simple modifications to the systems in general use for excitation of the coil of loud-speakers with one single diaphragm. The change consists of a cut in the magnetic circuit such that, by interposition of an annular core 2, two concentric air-gaps are formed. Due to this annulus 2, supported by the non-magnetic annulus 4, itself fixed on the cylindrical extremity 3 of core 1, the flux created by the current passing through the exciter coil 9 is compelled to pass through the first annular air-gap 5, within which moves the moving coil 6 of the diaphragm 11 of conical shape and reproducing the sounds of low and medium frequencies. 32

If as a first approximation we neglect losses, the whole of the flux ϕ reaches annulus 2 and is divided into two fluxes: the first, ϕ_1 passes through the interior annular air-gap 7 within which moves the moving coil 8 of diaphragm 12 which is for reproduction of the high notes. The second flux ϕ_2 passes through the lateral air-gap 10, which acts as a magnetic shunt. The function of this air-gap 10 is to collect the flux ϕ_2 which could not pass through the air-gap 7 because of the saturation of the magnetic ring which surrounds it. If a magnetic shunt such as 10 did not excite,

there would be in many cases a considerable reduction in the induction in the air-gap 5. By suitable location and dimensioning of the magnetic shunt 10, it is possible to realise, in the most varied conditions of intensity, the distribution of the magnetic field between the two air-gaps 5 and 7.

It must be mentioned that there may however be cases where this magnetic shunt is not necessary.

Amongst the principal advantages offered by an arrangement of this type, we may mention the following:

1. Simplicity of construction, resulting from the fact that there is only one exciter system;
2. The possibility of obtaining the greatest field intensity in the air-gap corresponding to the small diaphragm intended for reproduction of the high notes;
3. The possibility of dimensioning the air-gaps in such a manner that the field intensities in the two principal air-gaps differ by as much as is necessary for the two diaphragms to have practically the same electro-acoustic outputs; it then becomes very easy to obtain a uniform response, over a very wide range of frequencies, from the loud-speaker which is the result of the group of two diaphragms;
4. The possibility of positioning the small diaphragm in the most appropriate position, which is at the peak of the large conical diaphragm;
5. The possibility of arranging for the air-gap within which moves the moving coil of the small diaphragm to be of a relatively large diameter without for all that having to refrain from providing it with a strong field intensity.

This latter characteristic is of great importance since it makes it possible to provide the small diaphragm with a moving coil of large diameter, capable of carrying an electrical power with a value comparable with, although less than, that dissipated by the moving coil of the large diaphragm. This possibility makes it possible to realise loud-speakers characterised both by their wide frequency range and by their large power.

Experience shows that, by adoption of the type of loud-speaker illustrated in the diagram, and by suitable distribution of the field intensities between the various air-gaps, it is possible to obtain a true response over an extraordinarily wide frequency range.

One last characteristic of the invention lies in the shape of the ring 13, for fixing and centering of the suspension edge of the small diaphragm 12. This part is annular and its interior surface is conical which prolongs towards the centre of the system the surface of the large diaphragm considered in its rest position. This results in a better diffusion of sounds of very high frequency (close to the limit of audibility) produced by the small diaphragm 12.

The example illustrated is that of a loud-speaker where the air-gaps share a flux produced by an electro-magnet; there is however no reason why the electro-magnet should not be replaced by a permanent magnet of suitable power to give equivalent results.

SUMMARY

A. Loud-speaker with two vibrating diaphragms, characterised in that the two moving coils corresponding to these diaphragms are controlled by magnetic fields originating in one single source, and that in addition the following further characteristics are present either fully or partially:

1. Loud-speaker as in A in which this single source is an exciter coil through which a current passes;

2. Loud-speaker as in A in which this single source is a permanent magnet.

3. Loud-speaker as in A, 1 and 2 in which the necessary two magnetic fields are obtained by twice cutting into the course of the flux through the iron, this flux originating from one single magnetic circuit, by interposition of a magnetic annulus so arranged as to form two concentric air-gaps, associated respectively with the two moving coils of the diaphragms, with the possible

addition of a third air-gap (lateral) which, as a result of the passage of the flux parallel to the annular air-gap of small diameter, acts as a magnetic shunt and, of suitable dimensions, ensures a proper distribution of the flux in the two principal air-gaps.

4. Loud-speaker as in 3 characterised in that this magnetic shunt may, if necessary, be of such dimensions as to establish between the field intensities existing in the said air-gaps, a ratio such that the reproduction of the frequencies corresponding respectively to the two diaphragms is effected under conditions of practically uniform electro-acoustic output;

5. Loud-speaker as in 3 characterised in that the exciter system is arranged in such a manner as to permit the realisation of the desired relative positions of the two diaphragms;

6. Loud-speaker as in 3 and 5 characterised in that the small diaphragm is fixed to its moving coil by its outer edge and that its shape gives it considerable rigidity;

7. Loud-speaker having the previous characteristic and also characterised in that the annular part serving to centre the small diaphragm and its coil, has such a profile as to prolong towards the centre of the system the conical surface of the large diaphragm which surrounds it.

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Pl. unique